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ABSTRACT

This curriculum guide for a 1-semester or 1-year course in transportation provides activities that show and explain many of the occupations, devices, and systems that are related to transportation on land, water, air, and space. The guide contains competencies (task lists), student competency records, and management sheets. Management sheets, which serve as lesson outlines used for 1 or more days, include the following: an introduction, an enabling objective, a performance objective, an equipment and supplies list, a performance standard, suggested references for teachers and students, activities, and evaluation criteria. Some of the topics covered by the activities are: classification of transportation systems; and planning land, marine, air, and space transportation systems. The guide contains six appendixes: (1) information and record sheets; (2) support material on hot air balloons; (3) a tool and equipment list; (4) a supply list; (5) a 17-item bibliography; and (6) a facility layout. (KC)

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Curriculum Guide for Technology Education Transportation Systems

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INTRODUCTION

Transportation is an industry concerned with the important task of moving goods, materials, and people from one location to another. This industry has been in existence since animals and man came into being. Throughout history people have shown great innovation in solving the problem of how to move their possessions and themselves over land, in the water, in the air, and now in space. The technology of transportation has advanced rapidly and will change even more in the next decade. The study of transportation systems and related occupations can be very informative. Studying about the occupations of planning, designing, building, and operating transportation systems that move goods, materials, and people from one location to another location can teach students about the variety of careers in the transportation cluster and related career clusters. Those students planning business cluster careers need to understand how transportation systems operate if they are to move the people or products involved in their industry.

This curriculum guide provides the students with interesting and practical activities that show and explain many of the occupations, devices, and systems that are related to transportation. The curriculum guide is divided into several sections which present units about transportation on land, water, air, and space. The student will be involved in the study of transportation through reading, listening, observing, and manipulative type activities. The activities also are designed to bring out the ingenuity of each student. The student is asked to think and use problem solving techniques.

BROAD GOALS AND OBJECTIVES

The students will

1. Become aware of the many forms of transportation in the world today.

2. Acquire an awareness of the importance of transportation in today's world.

3. Become familiar with transportation systems and their contribution toward moving people, materials, and goods.

4. Acquire an understanding of the interrelationship between transportation and our society.

5. Become aware of land transportation systems and the vast network necessary to operate such systems.

6. Become aware of water transportation systems and the vast network necessary to operate such systems.

7. Become aware of air transportation systems and the vast network necessary to operate such systems.

8. Acquire an understanding of the significant contributions that space technology has given to the human race.

9. Become aware of the ways that stationary transportation systems, conveyers, pipelines, elevators, etc. have improved the transportation of materials and people.

10. Develop insight and understanding of the transportation industry, its place in our society, and the free enterprise system.

11. Experience a variety of laboratory and classroom activities with emphasis upon the orientation and exploration of occupational transportation clusters.

12. Become aware of the considerations for choosing a particular transportation system i.e. cost, speed, flexibility, conservation, and security.

13. Become aware of the impacts of transportation on society i.e. social, environmental, and standard of living.

HOW TO USE THE CURRICULUM GUIDE

The curriculum guide is designed to be used in an eighteen (18) week (90 days) or a thirty-six (36) week (180 days) course. The competencies that should be presented in the 18 week course are indicated with an asterisk (*). All of the competencies should be used in the 36 week course. The time devoted to each competency should be determined by the instructor. The activities in Appendix A are included as an aid to the instructor. These activities can be modified, shortened, or lengthened to meet the needs of each classroom situation. Activities from other sources may be used to supplement the suggested activities.

This curriculum guide is designed for students in the secondary school system, particularly the Industrial Technology students.

COMPETENCIES

TASK: Classification of Transportation Systems

* TRA-001. Identify land transportation systems

* TRA-002. Identify marine transportation systems

* TRA-003. Identify atmospheric transportation systems

* TRA-004. Identify space transportation systems

TASK: Classification of Transportation Systems According to What They Carry

* TRA-005. Identify transportation systems that move people

* TRA-006. Identify transportation systems that move goods

* TRA-007. Identify transportation systems that move materials

TASK: Plan a Land Transportation System

TRA-008. Plan a transportation terminal for people, goods, and/or materials

TRA-009. Design a transportation system for moving people, goods, and/or materials over/under the land

* TRA-010. Determine the distance, direction, and travel time between locations

TRA-011. Design and construct a land transportation vehicle that will carry people, goods and/or materials safely

* TRA-012. Design and construct a land transportation vehicle for maximum speed

TASK: Plan a Marine Transportation System

TRA-013. Design a marine terminal for loading and unloading people, goods, and/or materials

TRA-014. Design a marine vehicle

* TRA-015. Determine the load capacity and economy of a marine vehicle

TRA-016. Identify the purpose of dams, locks, and channeled waterways

TRA-017. Determine the distance, direction, and travel time between locations

TASK: Plan an Atmospheric Transportation System

TRA-018. Plan an atmospheric terminal for moving people, goods, and/or materials

* TRA-019. Design and construct a heavier than air vehicle

* TRA-020. Design and construct a lighter than air vehicle

TRA-021. Determine distance, direction, and travel time between two locations

TASK: Plan a Space Transportation System

TRA-022. Design and build a launch terminal

TRA-023. Design a space station

* TRA-024. Design and construct a space vehicle that will transport goods safely

The competencies marked with asterisks must be taught in an eighteen (18) week course. All of the competencies must be taught in a thirty-six (36) week course.

STUDENT COMPETENCY RECORD

School _____
Student _____

School Year _____
Instructor's Name _____
Course Title Transportation
Classification _____

Student Address _____
_____ _____
Zip

Comments _____
_____
_____
_____
_____

The student should be evaluated according to the performance ratings listed. Indicate on this form the numeric rating of the student's performance for each item.
(1) Competency in Process
(2) Competency Performed with Close Supervision
(3) Competency Performed with Limited Supervision
(4) Competency Performed without Supervision

COMPETENCIES

	*TRA-001	Identify land transportation systems.
	*TRA-002	Identify marine transportation systems.
	*TRA-003	Identify atmospheric transportation systems.
	*TRA-004	Identify space transportation systems.
	*TRA-005	Identify transportation systems that move people.
	*TRA-006	Identify transportation systems that move goods.
	*TRA-007	Identify transportation systems that move materials.
	TRA-008	Plan a transportation terminal for people, goods, and/or materials.
	TRA-009	Design a transportation system, for moving people, goods, and materials over and/or under the land.
	*TRA-010	Determine the distance, direction and travel time between locations.
	TRA-011	Design and construct a land transportation vehicle that will carry people, goods and/or materials safely.

	*TRA-012	Design and construct a land transportation vehicle for maximum speed.
	TRA-013	Design a marine terminal for loading and unloading people, goods &/or materials.
	TRA-014	Design a marine vehicle.
	*TRA-015	Determine the load capacity and economy of a marine vehicle.
	TRA-016	Identify the purpose of dams, locks, and channeled waterways.
	TRA-017	Determine the distance, direction and travel time between locations.
	TRA-018	Plan an atmospheric terminal for moving people, goods, and/or materials.
	*TRA-019	Design and construct a heavier than air vehicle.
	*TRA-020	Design and construct a lighter than air vehicle.
	TRA-021	Determine the distance, direction and travel time between two locations.
	TRA-022	Design and build a launch terminal.
	TRA-023	Design a space station.
	*TRA-024	Design and construct a space vehicle that will transport goods safely.

MANAGEMENT SHEETS

CLASSIFICATION OF TRANSPORTATION SYSTEMS

PERFORMANCE OBJECTIVE (1 Day)

TASK/COMPETENCY: TRA-001. Identify land transportation systems.

EQUIPMENT AND SUPPLIES: None.

STANDARD OF PERFORMANCE: The student will be able to list six types of land transportation methods and describe the purpose of each with an accuracy of seventy (70) per cent.

REFERENCES:

TEACHER	STUDENT
1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Development of Land Transportation b. Transportation, A Guide for Teachers, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Development of Land Transportation	1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Development of Land Transportation

ACTIVITIES:

TEACHER	STUDENT
1. Have students read about the development of land transportation in the recommended text.	1. Read about the development of land transportation in the recommended text.
2. Discuss with the students the basic concepts of land transportation systems.	2. Discuss with the instructor types of land transportation systems.
3. Walk around the school building and identify types of land transportation systems.	3. Make a list of the types of transportation systems found around the school.
4. If possible, visit several local transportation systems (bus station, train station, taxi company, truck terminal, etc.).	4. Prepare a list of six transportation systems and describe the purpose of each.

CLASSIFICATION OF TRANSPORTATION SYSTEMS

PERFORMANCE OBJECTIVE (1 Day)

TASK/COMPETENCY: TRA-002. Identify marine transportation systems.

EQUIPMENT AND SUPPLIES: None.

STANDARD OF PERFORMANCE: The student will be able to list three types of marine transportation systems and describe the purpose of each.

REFERENCES:

TEACHER	STUDENT
1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Development of Marine Transportation. b. Transportation, A Guide for Teachers, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Development of Marine Transportation.	1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Development of Marine Transportation.

ACTIVITIES:

TEACHER	STUDENT
1. Have students read about the development of marine transportation in the recommended text.	1. Read about the development of marine transportation in the recommended text.
2. Discuss with the students the basic concepts of marine transportation systems.	2. Discuss with the instructor various types of marine transportation systems.
3. If possible, visit several local marine transportation systems.	3. Prepare a list of three transportation systems and describe the purpose of each.

CLASSIFICATION OF TRANSPORTATION SYSTEMS

PERFORMANCE OBJECTIVE (1 Day)

TASK/COMPETENCY: TRA-003. Identify atmospheric transportation systems.

EQUIPMENT AND SUPPLIES: None.

STANDARD OF PERFORMANCE: The student will be able to list four types of atmospheric transportation systems and describe the purpose of each.

REFERENCES:

TEACHER	STUDENT
1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Development of Air Transportation b. Transportation, A Guide for Teachers, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Development of Air Transportation	1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Development of Air Transportation

ACTIVITIES:

TEACHER	STUDENT
1. Have students read about the development of air transportation in the recommended text.	1. Read about the development of air transportation in the recommended text.
2. Discuss with the students the basic concepts of atmospheric transportation systems.	2. Discuss with the instructor types of atmospheric transportation systems.
3. If possible, visit several local atmospheric transportation systems.	3. Prepare a list of four types of atmospheric transportation systems and describe the purpose of each.

CLASSIFICATION OF TRANSPORTATION SYSTEMS

PERFORMANCE OBJECTIVE (1 Day)

TASK/COMPETENCY: TRA-004. Identify space transportation systems.

EQUIPMENT AND SUPPLIES: Pictures of space vehicles and space stations.

STANDARD OF PERFORMANCE: The student will be able to list two types of space transportation systems and describe the purpose of each with an accuracy of seventy (70) per cent.

REFERENCES:

TEACHER	STUDENT
1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Development of Space Transportation b. Transportation, A Guide for Teachers, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Development of Space Transportation.	1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications Inc. Development of Space Transportation

ACTIVITIES:

TEACHER	STUDENT
1. Have students read about the development of space transportation in the recommended text.	1. Read about the development of space transportation in the recommended text.
2. Discuss with the students the basic concepts of space transportation systems.	2. Discuss with the instructor types of space transportation systems.
3. Show pictures of space transportation vehicles and space stations.	3. Prepare a list of two transportation systems and describe the purpose of each.

CLASSIFICATION OF TRANSPORTATION SYSTEMS ACCORDING TO WHAT THEY CARRY

PERFORMANCE OBJECTIVE (2 Days)

TASK/COMPETENCY: TRA-005. Identify transportation systems that move people.

EQUIPMENT AND SUPPLIES: None.

STANDARD OF PERFORMANCE: The student will be able to list ten transportation systems that move people from one location to another and describe two of the systems.

REFERENCES:

TEACHER	STUDENT
1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Moving People and Materials on Land	1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Moving people and Materials on Land.

ACTIVITIES:

TEACHER	STUDENT
1. Have students read about moving people and materials on land in the recommended text. 2. Discuss with the students the basic concepts of transporting people from one location to another. 3. Have the students look for methods of transporting people as they come to school and as they travel around the city and/or county.	1. Read about moving people and materials on land in the recommended text. 2. Discuss with the instructor types of transportation that move people from place to place. 3. On the way to and from school look for transportation systems that move people. 4. Make a list of ten transportation systems that move people from one location to another. Prepare an oral report to be presented to the class describing two of the systems.

CLASSIFICATION OF TRANSPORTATION SYSTEMS ACCORDING TO WHAT THEY CARRY

PERFORMANCE OBJECTIVE (3 Days)

TASK/COMPETENCY: TRA-006. Identify transportation systems that move goods.

EQUIPMENT AND SUPPLIES: None.

STANDARD OF PERFORMANCE: The student will be able to define, in writing, the term goods; list ten methods of transporting goods; and describe one method of transporting goods.

REFERENCES:

TEACHER	STUDENT
1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Methods of Transporting Goods	1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Methods of Transporting Goods

ACTIVITIES:

TEACHER	STUDENT
1. Have students read about transportation of goods in the recommended text.	1. Read about the transporting of goods in the recommended text.
2. Discuss with the students the basic concepts of transporting goods from one location to another.	2. Discuss with the instructor types of transportation that move goods from place to place.
3. Have the students look for methods of transporting goods from place to place as they travel to school and around the city and/or county.	3. Look for different types of transportation systems that move goods.
	4. Make a list of ten transportation systems that move goods. Prepare an oral report on one transportation system and present it to the class.
	5. Develop a definition for the term "goods".
	6. Prepare a written report describing one of the ten transportation systems that move goods.

CLASSIFICATION OF TRANSPORTATION SYSTEMS ACCORDING TO WHAT THEY CARRY

PERFORMANCE OBJECTIVE (3 Days)

TASK/COMPETENCY: TRA-007. Identify transportation systems that move materials.

EQUIPMENT AND SUPPLIES: Felt tip markers, posterboard, paint, paint brushes, etc.

STANDARD OF PERFORMANCE: The student will be able to define in writing the term materials, list ten methods of transporting materials, and score seventy (70) per cent on a "picturegram" of one of the listed systems using the evaluation criteria.

REFERENCES:

TEACHER	STUDENT
1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Transportation Systems that carry Materials	1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Transportation Systems that carry Materials

ACTIVITIES:

TEACHER	STUDENT
1. Have students read about transportation systems that carry materials in the recommended text.	1. Read about transportation systems that carry materials in the recommended text.
2. Discuss with the students the basic concepts of transporting materials from one location to another.	2. Discuss with the instructor the types of transportation that move materials from place to place.
3. Have the students look for methods of transporting goods as they come to school and as they travel around the city.	3. On your way to and from school look for transportation systems that move materials.
4. Discuss the techniques of developing a "picturegram." (sketching, color, proportions, etc,)	4. Make a list of ten transportation systems that move materials. Prepare an oral report on one of the above systems and present it to the class.
	5. Write your own definition of the term "materials".
	6. Prepare a "picturegram" of one of the above systems.

EVALUATION CRITERIA:

The "picturegram" will be evaluated on sketching techniques (40 points), color selection (10 points) and accuracy (50 points).

PLAN A LAND TRANSPORTATION SYSTEM

PERFORMANCE OBJECTIVE (5 to 7 Days)

TASK/COMPETENCY: TRA-008. Plan a land transportation terminal for moving people, goods, and/or materials.

EQUIPMENT AND SUPPLIES: Sketching equipment, paint, markers, posterboard, paint brushes, paper, etc.

STANDARD OF PERFORMANCE: The student will be able to sketch a set of plans for a land transportation terminal that will load and unload people, goods, and/or materials. The plan will be evaluated using the evaluation criteria and the student must attain a score of seventy (70) per cent.

REFERENCES:

TEACHER	STUDENT
1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Suburban Land Transportation Vehicles b. Transportation, Activity Manual, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Suburban-Metropolitan Transportation Systems	1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Suburban Land Transportation Vehicles b. Transportation, Activity Manual, De Olds, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Suburban-Metropolitan Transportation Systems

ACTIVITIES:

TEACHER	STUDENT
1. Have students read about suburban land transportation vehicles in the recommended text.	1. Read about suburban land transportation vehicles in the recommended text.
2. Discuss with the students the basic concepts of moving people, materials, and goods in, out and through a land transportation terminal.	2. Discuss with the instructor types of transportation systems that move people, materials, and goods in, out, and through land transportation terminals.
3. Help the students decide the type of land transportation terminal they want to design.	3. Select the type of land transportation terminal to be designed (people, goods, materials or a combination of two or more).
4. Discuss loading and unloading systems, methods, and devices with the students.	4. Make a pencil sketch of the terminal showing the loading area, unloading area, and the flow of people, goods, or materials through the terminal.
5. Discuss sketching techniques, color, and proportion with the students.	5. Discuss with the instructor methods of loading and unloading materials, and goods.
6. Have the students design a land transportation terminal. The students may use Activity 5 in the ACT book.	6. Design a land transportation terminal. Activity 5 in the ACT book.

EVALUATION CRITERIA:

1. 0 to 10 points - sketching skills and techniques
2. 0 to 25 points - the unloading systems selected
3. 0 to 25 points - the loading systems selected
4. 0 to 25 points - the techniques used in moving through the terminal
5. 0 to 15 points - color selection

PLAN A LAND TRANSPORTATION SYSTEM

PERFORMANCE OBJECTIVE (7 to 10 Days)

TASK/COMPETENCY: TRA-009. Design and build a transportation system for moving people, goods, and/or materials.

EQUIPMENT AND SUPPLIES: Cardboard; paint; brushes; glue; saw; plywood; knives; plaster; wood; tape; many types of toy trucks, trains, cars, people; balsawood; etc.

STANDARD OF PERFORMANCE: The students will be able to design and build a model transportation system for moving people, goods, and/or materials and score seventy (70) per cent or above when evaluated according to the evaluation critera.

REFERENCES:

TEACHER	STUDENT
1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Land Transportation Systems b. Transportation, Activity Manual, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Transbus, Railbed Design, Rapid Transit System, Elevator, Rail Passenger Car, and Rail Classification Yard (Have the students select one or more of the listed activities)	1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Land Transportation Systems b. Transportation, Activity Manual, De Old, Alan R., Everett Sheets, and William Alexander, Davis Publications, Inc. Transbus, Railbed Design, Rapid Transit System, Elevator, Rail Passenger Car, and Rail Classification Yard.

ACTIVITIES:

TEACHER	STUDENT
1. Have the students read the material on land transportation in the recommended text.	1. Participate in a discussion of land transportation systems and read the assigned material in the recommended text.
2. Discuss with the students the types of land transportation systems used to move people, materials and goods from one location to another.	2. Discuss with the instructor the type of transportation system that will be designed and constructed. (More than one student may work on the same model.
3. Help the student(s) decide on a transportation system for this activity. More than one student may work on a model.	3. At this time the student may want to select one of the activities in the ACT book
4. Suggest to the students that they may want to do one of the activities in the ACT book.	4. Make sketches of the model.
5. Demonstrate the proper use of all tools used in constructing the model.	5. Select the materials to be used in building the model.
6. Outline the procedure for writing the report.	6. Build the model.
	7. Write a two to four page report describing the operation and purpose of the model.

EVALUATION CRITERIA:

1. Sketch (20 points)
2. Construction (30 Points)
3. Creativity (30 points)
4. Written report (20 points)

PLAN A LAND TRANSPORTATION SYSTEM

PERFORMANCE OBJECTIVE (7 to 10 Days)

TASK/COMPETENCY: TRA-010. Determine the distance, direction, cost, and travel time between two locations.

EQUIPMENT AND SUPPLIES: Boxes of different sizes to represent vans, trains, tractor-semitrailer, boxes to represent materials to be shipped, road maps, UPS schedules, postage rates, bus schedules, etc.

STANDARD OF PERFORMANCE: The student will be able to determine the cost of transporting given materials from four locations to a single location as cheaply and as quickly as possible with seventy (70) per cent accuracy using the evaluation criteria.

REFERENCES:

TEACHER	STUDENT
1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Development of Land, Marine, and Air Transportaion	1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Development of Land, Marine, and Air Transportation

ACTIVITIES:

TEACHER	STUDENT
1. Have the students look at the land transportation maps in the recommended text.	1. Look for the land maps in the recommended text.
2. Demonstrate how to use a compass and a map to determine direction.	2. Practice the use of a compass.
3. Teach the students how to read a map	3. Practice reading a map.
4. Show the students how to calcuate the size and the relationship between size and the number of boxes per load.	4. Calculate the number of boxes that can be loaded into each transportatin device.
5. Describe the system of estimating travel time between locations on a map.	5. Practice placing the boxes in the simulated vehicles.
6. Describe the type of vehicles that can be used, their load capacity, and size of containers that will fit into the cargo space.	6. Calculate the load that each vehicle can carry and calculate the weight of the boxes that could be placed in that vehicle.
7. Explain the problem: They are to move the given cargo from one or more cities to a single city. They do not have to use all of the vehicles listed.	7. Determine the vehicles that are to be used in transporting the cargo from the starting location to the final location.
	8. Calculate the cost per mile, total moving cost, and time to move the cargo.

EVALUATION CRITERIA:

a) cheapest 95 points
b) fastest 95 points
c) fastest and cheapest 100 points
and not one of the two above.
d) completion of project 90 points

PLAN A LAND TRANSPORTATION SYSTEM

PERFORMANCE OBJECTIVE (10 to 15 Days)

TASK/COMPETENCY: TRA-011. Design and construct a land transportation vehicle that will carry people, goods, and/or materials safely.

EQUIPMENT AND SUPPLIES: 2 X 4's, screws, wheels, axles, 1 X 4, rubber bands, tacks, paint, brushes, large eggs, and test ramp.

STANDARD OF PERFORMANCE: The student will build a safety restraint system that will protect an egg when a test vehicle is crashed into a wall. The success of the student restraint system will be judged by the evaluation criteria.

REFERENCES:

TEACHER	STUDENT
1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Automotive Research and Development b. Transportation, A Guide for Teachers, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Automotive Research and Development	1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications Inc. Automotive Research and and Development

ACTIVITIES:

TEACHER	STUDENT
1. Have the students read about automotive research and development in the recommended text.	1. Read about automotive research and development in the recommended text.
2. Discuss the interior passenger space of different types of vehicles.	2. Discuss the space requirements for passengers inside different types of vehicles.
3. Discuss the reasons for and benefits of safety restraint devices and systems.	3. Identify the points of impact inside a vehicle and the types of safety restraint systems that may be used in a vehicle.
4. Give the students the materials that will be used to design and construct a safety restraint system for the provided vehicle.	4. Check the materials against the materials list in the safety restraint design system package.
5. Explain the rules that must be followed in restraining the passenger.	5. Ask questions about the rules that are not understood.
6. Explain that the "passenger" must survive the crash test.	6. Design and construct a safety restraint system using the safety restraint package.
7. Test the students' restraint system.	7. Test the restraint system.

EVALUATION CRITERIA:

1. The egg must survive all situations that may develop during the crash test.
2. The egg must survive the first test angle of 15 degrees. 10 points
3. Each 10 degree increase survived will receive an additional 10 points.
4. The last egg to survive will receive an additional 10 points.
5. If the egg is thrown from the vehicle, 5 points will be subtracted and no points will be added. If the egg survives, 10 points will be subtracted and the student may continue.

PLAN A LAND TRANSPORTATION SYSTEM

PERFORMANCE OBJECTIVE (10 to 15 Days)

TASK/COMPETENCY: TRA-012. Design and construct a land transportation vehicle for maximum speed.

EQUIPMENT AND SUPPLIES: Basswood block 12" X 1 5/8" X 2 3/4", wheels, axles, paint, brushes, wood files, saws, and a wind tunnel.

STANDARD OF PERFORMANCE: The student will be able to design and build a model land transportation vehicle which will be evaluated according to the evaluation criteria.

REFERENCES:

TEACHER	STUDENT
1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Automotive Research and Development b. Transportation, A Guide for Teachers, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publicataion Inc. Automotive Research and Development	1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Automotive Research and Development b. Transportation, Activity Manual, De Old, Alan R,. Everett Sheets, and William Alexander. Davis Publications Inc. Research and Development Transportation

ACTIVITIES:

TEACHER	STUDENT
1. Have the students read about automotive research and development in the recommended text.	1. Read about automotive research and development in the recommended text.
2. Discuss the process and steps used to design a land vehicle.	2. Study the design process and make sketches of the vehicle that is to be constructed. Make a final design sketch.
3. Demonstrate the use of the tools to be used during the construction of the vehicle.	3. Construct the vehicle using the final design sketch.
4. Demonstrate the use of a wind tunnel and how to check the air flow over the vehicle.	4. Check the vehicle in the wind tunnel and make any desired changes.
5. Demonstrate the techniques used in painting the vehicle.	5. Paint the vehicle.
6. Explain the procedures, safety rules, and duties of workers needed to conduct a race.	6. Select a race worker's position and perform the duties of that position during the race.
7. Conduct the race.	7. Participate in the race.
	8. Prepare a written report on the race results. This may include an explanation of the finishing position of each vehicle.

EVALUATION CRITERIA:

1. Design planning sheets	30 points
2. Design	20 points
3. Workmanship	20 points
4. 5 fastest vehicles	30 points each
5. 5 next fastest vehicles	25 points each
6. 10 next fastest vehicles	20 points each
7. Completion of race	15 points each

PLAN A MARINE TRANSPORTATION SYSTEM

PERFORMANCE OBJECTIVE (5 to 7 Days)

TASK/COMPETENCY: TRA-Ø13. Design a marine terminal for loading and unloading people, goods, and/or materials.

EQUIPMENT AND SUPPLIES: Posterboard, felt tip markers, paint, brushes, plaster, knives, tape, glue, etc.

STANDARD OF PERFORMANCE: The student will be able to design a marine terminal for loading, unloading, and moving materials, goods, and people. The student must attain a score of seventy (7Ø) per cent based on the evaluation criteria.

REFERENCES:

TEACHER	STUDENT
1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Seaports and Shipping Procedures b. Transportation, A Guide for Teachers, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Seaports and Shipping Procedures	1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Seaports and Shipping Procedures b. Transportation Activity Manual, De Old, Alan R., Everett Sheets and Williams Alexander. Davis Publications, Inc. Seaports for Modern Ships

ACTIVITIES:

TEACHER	STUDENT
1. Have the students read about seaports and shipping procedures in the recommended text.	1. Read about seaports and shipping products in the recommended text.
2. Discuss the purpose of marine terminals.	2. Discuss the purpose of marine terminals.
3. Discuss the methods of unloading, loading, and moving people materials, and/or goods in a terminal.	3. Start making notes and sketches on how to unload, load, and move materials, goods, and people in a marine terminal.
4. Have the students complete Activity 20 in the ACT book.	4. Complete Activity 20 in the ACT book.
5. Help the students with any problems or questions they have in designing and sketching the marine terminal.	5. Design a marine terminal used for loading, unloading, and moving materials, goods, and people.

EVALUATION CRITERIA:

1. Design procedure - 20 points
2. Loading design - 20 points
3. Unloading design - 20 points
4. Movement within the terminal - 20 points
5. Workmanship - 20 points

PLAN A MARINE TRANSPORTATION SYSTEM

PERFORMANCE OBJECTIVE (7 to 10 Days)

TASK/COMPETENCY: TRA-014. Design a marine vehicle.

EQUIPMENT AND SUPPLIES: Wood blocks 2" X 4" x 6", cardboard, screen-wire, plaster, sheet metal, paint, brushes, test tank, knives, saws, sand, plastic bags, etc.

STANDARD OF PERFORMANCE: The student will design a marine vehicle which will be evaluated using the evaluation criteria. A score of seventy (70) per cent must be attained using the evaluation criteria.

REFERENCES:

TEACHER	STUDENT
1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Marine Transportation Systems b. Transportation, A Guide for Teachers, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Marine Transportation Systems	1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Marine Transportation Systems b. Transportation Activity Manual, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publication Inc. Marine Transportation Systems

ACTIVITIES:

TEACHER	STUDENT
1. Have the students read about marine transportation systems in the recommended text.	1. Read about marine transportation systems in the recommended text.
2. Discuss the design process and the important concepts in marine vehicle hull design. a. Planing hulls b. Displacement hulls d. Displacement c. Load stability e. Floatation level f. Wake g. Speed h. Ride comfort i. Maneuvering ability	2. Take notes and make sketches of potential marine vehicle hull designs.
3. Give the students the materials that will be used in the construction of the marine vehicle.	3. Make sketches of marine vehicles using good design processes. Select a final design for a marine vehicle.
4. Demonstrate the safe use of all the tools that will be used in the construction of a marine vehicle.	4. Check to see if all of the materials needed are in the package for construction of the marine vehicle. Construct the vehicle.
5. Demonstrate waterproofing techniques.	5. Waterproof the vehicle if necessary.
6. Demonstrate the use of the test tank.	
7. Have the students complete one or more of the activities in the ACT book	6. Complete one or more of the activities in the ACT book
8. Explain how to test the vehicle for stability.	7. Test the stability of the vehicle.

9. Explain how to test the weight to load capacity of the vehicle. 10. Test the marine vehicle using the information sheet in Appendix A on page 73.	9. Determine the weight to load capacity of the vehicle.

EVALUATION CRITERIA:

1. Design procedure and sketch	30 points
2. Material used other than wood	10 points
3. Stability of vehicle	20 points
4. Weight to load capacity	30 points
5. Workmanship	10 points

PLAN A MARINE TRANSPORTATION SYSTEM

PERFORMANCE OBJECTIVE (5 to 7 Days)

TASK/COMPETENCY: TRA-Ø15. Determine the load capacity and economy of a marine vehicle.

EQUIPMENT AND SUPPLIES: Marine vehicle, simulated lake, sand bags of different weights, and simulated power source.

STANDARD OF PERFORMANCE: The student will be able to determine the load capacity and economy of a marine vehicle with seventy (70) per cent accuracy using the evaluation criteria.

REFERENCES:

TEACHER	STUDENT
1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Ocean Transport and Ship Sturcture b. Transportation, A Guide for Teachers, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Ocean Transport and Ship Structure	1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Ocean Transport and Ship Structure b. Transportation Activity Manual De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications Inc. Marine Transportion Systems

ACTIVITIES:

TEACHER	STUDENT
1. Have the students read about ocean transport and ship structures in the recommended text.	1. Read about ocean transport and ship structure in the recommended text.
2. In this activity the students can use the vehicle that was constructed in Activity 14 or one supplied by the instructor.	2. Select the marine vehicle to be used and check it for possible damage or problems that might cause it to perform properly
3. Demonstrate the use of the test tank.	3. Have questions clarified during the demonstration of the test tank.
4. Explain the testing rules: a. The vehicle must not take on water during the speed test. b. During the economy runs, the cargo and inside of the vehicle must remain dry. c. The vehicle must not take on water during the capacity testing and the cargo must remain dry.	4. Test the vehicle for capacity, speed, and economy.
5. Help with the testing of the vehicles and answer any questions. Use the information sheet in Appendix A on page 75.	5. Calculate the profit that the vehicle would make in the specified number of trips.

EVALUATION CRITERIA:

1. Correct measurement of capacity within + or - 10% . . . . . 30 points

2. Correct measurement of the maximum speed of the vehicle within + or - 10% . . 30 points

3. Five (5) most profitable vehicles . . . . . 40 points

4. All other vehicles that complete the project . . . . . 25 points

PLAN A MARINE TRANSPORTATION SYSTEM

PERFORMANCE OBJECTIVE (3 to 5 Days)

TASK/COMPETENCY: TRA-016. Identify the purpose of dams, locks, and channeled waterways.

EQUIPMENT AND SUPPLIES: None.

STANDARD OF PERFORMANCE: The student will be able to list 5 purposes of locks, 6 reasons for dams, and 4 reasons for channeled waterways with an accuracy of seventy (70) percent.

REFERENCES:

TEACHER	STUDENT
1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. St. Lawrence Seaway-Great Lakes System b. Transportation, A Guide for Teachers, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. St. Lawrence Seaway-Great Lakes System	1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. St. Lawrence Seaway-Great Lakes System b. Transportation Activity Manual, De Old, Alan R., Everett Sheets, and William Alexander, Davis Publicatinos, Inc. Planning and Designing Canal and Designing a Lock.

ACTIVITIES:

TEACHER	STUDENT
1. Have the students read about the St. Lawrence Seaway in the recommended text.	1. Read about the St. Lawrence Seaway in the recommended text.
2. Discuss the purpose of dams.	2. Make a list of the purposes of dams.
3. Discuss the purpose of locks.	3. Prepare a list of the purposes locks.
4. Discuss the purpose of channeled waterways.	4. List the reasons why waterways are channeled.
5. The students may also complete Activities 15 and 16 in the ACT book.	5. If time permits, complete Activities 15 and 16 in the ACT book.

PLAN A MARINE TRANSPORTATION SYSTEM

PERFORMANCE OBJECTIVE (5 to 7) Days

TASK/COMPETENCY: TRA-Ø17. Determine the distance, direction, and travel time between marine locations.

EQUIPMENT AND SUPPLIES: Maps, charts, simulated marine vehicles, simulated cargo, simulated waterway, compass, dividers, and rulers.

STANDARD OF PERFORMANCE: The student will be able to calculate the distance between given locations and determine the direction of travel, time of travel, and cost with an accuracy of + or - 2%.

REFERENCES:

TEACHER	STUDENT
1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Navagation, Guidance Systems, Seaports and Shipping Procedures	1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Navigation, Guidance Systems, Seaports and Shipping Procedures

ACTIVITIES:

TEACHER	STUDENT
1. Have the students read about navigation, guidance systems, seaports and shipping procedures.	1. Read about navigation, guidance systems, seaports, and shipping procedures.
2. Demonstrate how to read a compass.	2. Practice reading a compass.
3. Explain how to read marine maps and charts.	3. Practice reading marine maps and charts.
4. Demonstrate the method of determining the distance and time of travel between points on the maps and charts.	4. Practice estimating the distance and travel time between given points on maps and charts.
5. Explain how to calculate the cargo space and the cost of operating a marine vehicle.	5. Practice calculating the cost of operating a marine vehicle.

PLAN AN ATMOSPHERIC TRANSPORTATION SYSTEM

PERFORMANCE OBJECTIVE (5 to 7 Days)

TASK/COMPETENCY: TRA-Ø18. Plan an atmospheric terminal for moving people, goods, and/or materials.

EQUIPMENT AND SUPPLIES: Sketching materials, paper, felt tip pens, etc.

STANDARD OF PERFORMANCE: The student will be able to plan an atmospheric terminal for moving people, goods, and/or materials. The plans will be evaluated on sketching skills, location of loading, unloading, and movement within the terminal. The plans will be assigned numerical grades and placed in rank order. The student must score seventy (70) per cent of the highest score.

REFERENCES:

TEACHER	STUDENT
1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Airport Terminals and Facilities b. Transportation, A Guide for Teachers, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Airport Terminals and Facilities	1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Airport Terminals and Facilities b. Transportation Activity Manual, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications Designing an Airport Plan with Facilities

ACTIVITIES:

TEACHER	STUDENT
1. Have the students read about airport terminals and facilities in the recommended text.	1. Read about airport terminals and facilities in the recommended text.
2. Discuss the areas used to load and unload people and baggage in a airport.	2. Make quick sketches of a baggage area and what it should contain.
3. Discuss the check-in counter and lobby areas of airports.	3. Make quick sketches of an airport lobby and check-in counter.
4. Discuss the methods of controlling airplanes during landing and taking off from an airport.	4. Make quick sketches of the runways, control tower, and unloading areas of an airport.
5. Have the students plan and make a sketch of an airport using the activity in the ACT book on Designing an Airport Plan with Facilities.	5. Using the quick sketches make drawings of an airport. Follow the suggestions in the ACT book on Designing an Airport Plan with Facilities.

PLAN AN ATMOSPHERIC TRANSPORTATION SYSTEM

PERFORMANCE OBJECTIVE (10 to 15 Days)

TASK/COMPETENCY: TRA-019. Design and construct a heavier than air vehicle.

EQUIPMENT AND SUPPLIES: Paper, styrofoam, glue, balsawood, rubber bands, knives, paint, brushes, rulers, and wind tunnel.

STANDARD OF PERFORMANCE: The student will design and construct an airplane that will fly 50 feet or more.

REFERENCES:

TEACHER	STUDENT
1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Light Aircraft Structure, Forces Affecting Flight, and Rotary Wing Aircraft b. Transportation, A Guide for Teachers, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Light Aircraft Structure, Forces Affecting Flight, and Rotary Wing Aircraft 2. Suggested a. The Great International Paper Airplane Book, Mander, Jerry, George Dippel and Howard Gossage. Simon and Schuster.	1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Light Aircraft Structure, Forces Affecting Flight, and Rotary Wing Aircraft b. Transportation Activity Manual, De Old, Alan R., Everett Sheets and William Alexander. Davis Publications, Inc. Air Transportation Systems

Continued

b. Cut & Assemble Paper Airplanes That Fly, Baker, Arthur. Dover Publications, Inc.	

SELECTED INSTRUCTIONAL MATERIALS:

Disk/Apple II -- Glidepath. Harm Software.

ACTIVITIES:

TEACHER	STUDENT
1. Have the students read about light aircraft structure, forces affecting flight, and rotary wing aircraft.	1. Read about light aircraft structure, forces affecting flight, and rotary wing aircraft.
2. Discuss the concepts of why things fly: a. Lift b. Gravity c. Thrust d. Drag e. Angle of attack f. Center of pressure g. Relative wind h. Direction of flight	2. Complete activity number 24 in the ACT book.
3. Using a wind tunnel demonstrate the lifting qualities of a wing section.	3. Following the procedure in the ACT book, plot and construct a wing section. Test the wing in a wind tunnel. (A wind tunnel test stand is shown in the ACT book.)

4. Discuss the concepts of controlling an aircraft: a. Roll b. Pitch c. Yaw d. Aileron e. Rudder f. Elevator g. Flaps h. Coordinated turn i. Dihedral 5. Have the students construct several types of aircraft and fly them in the laboratory.	4. Build different types of hand-launched gliders. a. Paper b. Balsa wood c. Styrofoam d. Rubber band powered

PLAN AN ATMOSPHERIC TRANSPORTATION SYSTEM

PERFORMANCE OBJECTIVE (10 to 15 Days)

TASK/COMPETENCY: TRA-020. Design and construct a lighter than air vehicle.

EQUIPMENT AND SUPPLIES: Glue, tissue paper, plastic garbage bags, scissors, heat source, cardboard tube, etc.

STANDARD OF PERFORMANCE: The student will be able to design and construct a lighter than air vehicle which will be able to carry a minimun load of one (1) ounce.

REFERENCES:

TEACHER	STUDENT
1. Recommended b. Have the students read the information found in Appendix B on page 105.	1. Recommended a. Read the information found in Appendix B on page 105.

ACTIVITIES:

TEACHER	STUDENT
1. Explain the difference between an airplane and a hot air balloon. Have the students read the information in Appendix B on page 105.	1. Read the background information in Appendix B on page 105.
2. Discuss the materials that may be used to construct a hot air balloon.	2. Decide what materials are going to be used in the construction of the hot air balloon.
3. Demonstrate the proper use of the hand tools to be used in the construction of the hot air balloon.	3. Lay out the patterns for the parts of the balloon.
4. Demonstrate the different methods of joining the parts that will form the balloon.	4. Assemble the parts and check for leaks.
5. Demonstrate the use of the hot air gun or blower that will be used to fill the balloon	5. Prepare the balloon and fill it with hot air. Add weight to the gondola. Each weight should be one ounce.
	6. Record the total weight of the balloon, gondola, and weights.

PLAN AN ATMOSPHERIC TRANSPORTATION SYSTEM

PERFORMANCE OBJECTIVE (5 to 7 Days)

TASK/COMPETENCY: TRA-Ø21. Determine distance, direction, and travel time between two locations.

EQUIPMENT AND SUPPLIES: Charts, maps, compass, dividers, rulers, simulated vehicles, etc.

STANDARD OF PERFORMANCE: The student will be able to calculate the distance, direction, and travel time between two locations with an accuracy of + or - 2 per cent.

REFERENCES:

TEACHER	STUDENT
1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Air Navigation and Weather	1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Air Navigation and Weather

ACTIVITIES:

TEACHER	STUDENT
1. Have the students read about air navigation and weather in the recommended text.	1. Read about air navigation and weather in the recommended text.
2. Review the use of a compass.	2. Review the use of a compass.
3. Demonstrate how to read air maps and charts.	3. Practice reading maps and charts.
4. Demonstrate how to plot the direction of an airplane when it has a. Head wind b. Tail wind c. Left side wind d. Right side angular wind	4. Practice plotting the direction an airplane will travel in different winds.
5. Give the students a map, two locations, wind speed, wind direction, and airplane speed. Have the students plot the direction, distance, and travel time between the two locations.	5. Calculate the direction and travel time of an airplane from the given information.

PLAN A SPACE TRANSPORTATION SYSTEM

PERFORMANCE OBJECTIVE (5 Days)

TASK/COMPETENCY: TRA-022. Design and build a launch terminal.

EQUIPMENT AND SUPPLIES: Sheet metal or plastic, metal rod 3 feet long, electrical wire, solder, soldering gun, glue, electrical switch, batteries, cutting pliers, and knife.

STANDARD OF PERFORMANCE: The student will be able to design and construct a launch terminal that will successfully and safely launch a model rocket.

REFERENCES:

TEACHER	STUDENT
1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Support Facilities 2. Suggested a. Hand Book of Model Rocketry, Stine, G. Harry. Arco Publishing, Inc. p. 101 to 118. b. The Rocket Book, Cannon, Robert L. and Michael A. Banks. Prentice-Hall, Inc. p. 51 to 78. c. Model Rocket Launch Systems, Cannon, Robert L. Estes Industries.	1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Support Facilities

ACTIVITIES:

TEACHER	STUDENT
1. Have the students read about support facilities in the recommended text. 2. Discuss the features that a launch system must contain. a. Remote on-off switch b. Guide rod c. Deflector shield d. Safety key e. Stability f. Safe distance from launcher g. Electrical supply h. Electrical connectors (clips) 3. Demonstrate the safe use of the tools that will be used in constructing the launcher.	1. Read about support facilities in the recommended text. 2. Make a sketch of the launch system to be constructed. 3. Obtain the materials needed to construct the launcher. With the supervision of the instructor build a rocket launch system. 4. Make a static test of the launch system.

PLAN A SPACE TRANSPORTATION SYSTEM

PERFORMANCE OBJECTIVE (5 to 7 Days)

TASK/COMPETENCY: TRA-023. Design a space station.

EQUIPMENT AND SUPPLIES: Sketching materials, paper, felt tip markers, etc.

STANDARD OF PERFORMANCE: The student will design a space station and make a sketch of the design. The space station sketch will be evaluated and arranged in rank order. Grades will be assigned by the instructor according to rank.

REFERENCES:

TEACHER	STUDENT
1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Space Transportation Systems b. Transportation, A Guide for Teachers, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Space Transportation Systems	1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Space Transportation Systems b. Transportation Activity Manual, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Space Transportation Systems

ACTIVITIES:

TEACHER	STUDENT
1. Have the students read about space transportation systems in the recommended text.	1. Read about space transportation systems in the recommended text.
2. Discuss the purpose of space stations. Have the students complete Activity 34 in the ACT book.	2. Complete Activity 34 in the ACT book.
3. Discuss the purpose of space stations.	
4. Discuss the working conditions of the workers in the space station.	
5. Discuss the possible dangers and how to protect the workers from these dangers.	
6. Have the students complete Activity 36 in the ACT book.	3. Design a space station and make sketches of the design. Use Activity 36 in the ACT as a guide.

PLAN A SPACE TRANSPORTATION SYSTEM

PERFORMANCE OBJECTIVE (10 to 15 Days)

TASK/COMPETENCY: TRA-024. Design and construct a space vehicle that will transport goods safely.

EQUIPMENT AND SUPPLIES: Model rocket kit, glue, knife, scissors, rocket engines, launch system, tracking system, and cargo.

STANDARD OF PERFORMANCE: The student will construct a rocket, which will safely launch and recover an egg.

REFERENCES:

TEACHER	STUDENT
1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Quest in Space and Working in Space b. Transportation, A Guide for Teachers, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Space Transportation Systems 2. Suggested a. Cut & Fold Extraterrestrial Invaders That Fly, Grater, Michael. Dover Publications, Inc. b. Cut & Fold Paper Spaceships That Fly, Grater, Michael. Dover Publications, Inc.	1. Recommended a. Transportation, De Old, Alan R., Everett Sheets, and William Alexander. Davis Publications, Inc. Quest in Space and Working in Space b. Transportation Activity Manual, De Old, Alan R., Everett Sheets and William Alexander. Davis Publications, Inc. Two Stage Rocket and Space Transportation Systems

SELECTED INSTRUCTIONAL MATERIALS:

Disk/Apple IIe and IIc — In Search of Space, Estes Industries.

Disk/Apple IIe and IIc — Flight, Estes Industries.

ACTIVITIES:

TEACHER	STUDENT
1. Have the students read about the quest in space and working in space in the recommended text.	1. Read about the quest in space and working in space in the recommended text.
2. Explain the differences between an airplane and a rocket.	2. Take notes on the differences between an airplane and a rocket.
3. Describe the factors that might cause a rocket to be unstable in flight. a. Center of gravity. b. Center of pressure. c. Fin area. d. Nose cone shape. e. Drag. f. Thrust.	3. Test a rocket for stability.
4. Discuss the problems that may be encountered when launching man into space and return to earth.	4. List ways that an egg may be safely launched and recovered.
5. Have the students build and fly a model rocket. Activity 4 in the ACT book can be used if a model rocket kit is not available.	5. Build and fly a model rocket. A kit or Activity 4 in the ACT book may be used to construct a rocket.
6. Have the students build a recovery system for an egg. The egg will be launched by a rocket.	6. Design a container that will fit a rocket and safely launch and recover an egg.

APPENDICIES

APPENDIX A

DETERMINE THE DISTANCE, DIRECTION, AND TRAVEL TIME BETWEEN LOCATIONS

Name: _____ Date: _____

Class Period: _____ Class Time: _____

PROBLEM:

Determine the distance, direction, and travel time between locations.

1. Given two locations, (example-Bowling Green and Lexington, Ky.) determine the distance between the two cities by:
   A. Highways
   B. Air travel
   C. Railroads
2. Determine the direction of travel from one city to the another city.
   (Use a compass and map)
3. Determine the time it takes to travel between the two cities.
   A. Highway
   B. Air
   C. Railroad
4. Determine the cost of shipping materials/goods between the locations.

LIMITATIONS:

1. Size of materials/goods to be shipped.

Quantity	Size H W L	Weight
A. 100 boxes	36" X 36" X 20"	65 lb. each
B. 50 crates	8' X 6' X 10'	1200 lb. each
C. 300 packages	76" X 14" X 20"	36 lb. each
D. 75 envelopes	12" X 10" x 1/16"	22 oz. each

2. Size of vehicles that can be used to ship materials/goods.

Vehicles	Number	Size H	Size W	Size L	Capacity
A. Trucks Semitrailer	7	13'6"	102"	48'	80,000 lb.Gross 16,000 lb.Empty
Vans	12	5'	6'	8'	7,000 lb.Gross 3,200 lb.Empty
Cars	36	5 passenger			2,980 lb.Empty
B. Trains Box cars	Rent any number	14"	10'	100'	200,000 lb.Gross 40,000 lb.Empty

3. Cost of shipping

Service	Size	Cost
A. UPS	103"(H+W+L) (70 lb. max.)	21 cents/lb.
B. U. S. Post Office	Standard envelopes	25 cents/oz 17 cents/oz over 1 ozs.
C. Car	Max. load 750 lb.	38 Cents/mile
D. Truck		158 cents/mile
E. Train		99 cents/mile

4. Average speed of each vehicle

A. UPS	Overnight
B. Post Office	Overnight
C. Car	60 mph
D. Truck	60 mph
E. Train	50 mph

5. The materials/goods must be shipped from an address to an address not just between the two cities.

RECORD SHEET

1. Distance between the two cities.

2. Types of transportation system(s) used to transport the materials/goods.

3. Cost of shipping by each transportation system.

4. Travel time for each of the transportation systems.

5. Total cost of transporting the materials/goods from city to city.

NOTE: The sizes of the materials/goods may constructed out of cardboard at a scale of 1 inch = 1 foot. The vehicles may also be constructed on the same scale. This will allow the students to fit the materials/goods into the vehicles and learn some of the problems in loading transportation vehicles.

DESIGN AND CONSTRUCT A LAND TRANSPORTATION VEHICLE THAT WILL CARRY PEOPLE, GOODS AND/OR MATERIALS SAFELY

Name: _____ Date: _____

Class Period: _____ Class Time: _____

PROBLEM:

Design and construct a land transportation vehicle that will carry people safely.

1. The vehicle must roll down an eight (8) foot incline and crash into a solid barrier.
2. The vehicle must withstand the impact.
3. The passenger (egg) must not be damaged upon impact.
4. The passenger (egg) must not be ejected from the vehicle upon impact.
5. The passenger must survive all conditions of the impact including roll overs.

DESIGN LIMITATIONS:

1. The vehicle must have four (4) wheels.
2. The length of the vehicle must be seven (7) inches.
3. The width of the vehicle must be three and one half (3 1/2) inches.
4. The height at the back must be four (4) inches.
5. The height at the front must not exceed two (2) inches.
6. The passenger compartment must be three and one half (3 1/2) inches long and three and one half (3 1/2) inches wide. The sides must be open.
7. The wheels can be of any size as long as they do not extend beyond the ends (front and back) of the vehicle.
8. The vehicle can be constructed of wood or any material approved by the instructor.
9. The passenger should be a Grade A large egg.
10. The passenger must be restrained by the materials provided by the instructor.
11. Thirty (30) minutes will be given to construct the safety restraint system. The construction time of the vehicle will be determined by the instructor.

Examples of restraint materials and limitations.

MATERIALS

1. Three (3) rubber bands.
2. Six thumb tacks.
3. One piece of styrofoam 3"x 2"x 1/2"

NOTE: The above material may be changed by the instructor.

LIMITATIONS

1. Only the bottom (large end) of the egg can be covered with the styrofoam.
2. The top two thirds of the egg must be at least one quarter (1/4) inch from all objects except restraint straps.
3. Only three restraint straps can cross over the egg. A doubled rubber band counts as two straps.
4. Thirty (30) minutes will be given for the construction of the safety restraint system.

TESTING THE VEHICLE.

1. The safety restraint system will be checked. If it does not conform to the limitations it will be rejected.
2. The vehicles will be assigned a testing position number.
3. The incline will be set at 15 degrees for the first run.
4. Each vehicle will be rolled down the test ramp one at a time.
5. At the end of the test the passenger will be checked. The vehicle will be disqualified if the passenger:
   A. Receives any damage upon impact.
   B. Receives any damage if the vehicle roll/tips over.
6. The surviving systems will be tested at a greater angle. Each test will be at an increase of 10 degrees until only one passenger survives.
7. No modification of the restraint system can be made during the testing. Only minor adjustments to the restraint system are allowed, such as, repositioning of a slipped strap.

TEST DATA AND RECORD SHEET

1. Does the restraint system meet the design criterion? YES NO
2. Did the passenger survive more than one impact angle? YES NO
   The restraint system will receive ten (10) points for each angle survived. If the passenger is ejected from the vehicle and is not damaged, ten (10) points will be subtracted from the score. If the passenger is damaged, five (5) points will be subtracted from the score and the restraint system will be disqualified from testing.

   15 degrees-----score _____
   25 degrees-----score _____
   35 degrees-----score _____
   45 degrees-----score _____
   55 degrees-----score _____
   65 degrees-----score _____
   75 degrees-----score _____
   85 degrees-----score _____
   90 degrees-----score _____

   Total _____
   Finish position _____

3. Explain why some of the restraint systems worked better than other restraint systems.

DESIGN AND CONSTRUCT A LAND TRANSPORTATION VEHICLE FOR MAXIMUM SPEED

Name: _____ Date: _____

Class Period: _____ Class Time: _____

PROBLEM:

Design a land vehicle for maximum speed.

1. Design a vehicle that can travel on land at actual speeds in excess of 40 miles per hour (scale speeds of 300 mph).

NOTE: The design development process should follow the unit in the design curriculum.

DESIGN LIMITATIONS:

Body Limitations	Minimum	Maximum
1. Length	12 in. (300 mm)	12 in. (300 mm)
2. Width (between wheels)	1 5/8 in. (42 mm)	1 5/8 in. (42 mm)
3. Height	2 3/4 in. (70 mm)	2 3/4 in. (70 mm)
4. Shape	3/8 in. (10 mm) Dia.	1 5/8 in. (70 mm)
5. Axle Housing	Axles must be enclosed	
6. Color	Any color	
7. Material	One piece wood	

Power Plant Limitations	
1. Size	CO_2 Cartridge Brand D
2. Location	1 1/4 in. (32mm) from bottom of car to center of cartridge
3. Housing size	Totally enclosed with 1/8 in. (3mm) minimum thickness around cartridge

Axle, Bearing, Wheel Limitations.	
1. Axle size	1/8 in. (3mm) Dia. X 2 1/2 in. (66mm) long
2. Material	Metal rod
3. Location	6 to 10 in. apart and 3/8 in. (from bottom of body)
4. Bearing	3/16 in. straw
5. Wheel size	
Front	1 5/8 in. (39mm) Dia. X 3/16 in. (5mm) wide
Rear	1 5/8 in. (39mm) Dia. X 3/4 in. wide

Steering System

1.	Screw eyes alignment	Centerline along bottom of body
2.	Distance between screw eyes	Minimum of 6 in. (152mm) apart

TESTING THE VEHICLE.

The CO dragster will be run on a Pitsco Race Track or equal system.

1. The design process (design planning sheets) will be evaluated. Items to be considered are steps in planning, neatness, line quality, dimensions, etc. The score will range from 0 to 30 points.

2. The design of the dragster will be evaluated on the basis of eye appeal and aerodynamics. The score will range from 5 to 20 points.

3. The quality of workmanship will be evaluated. This will include the smoothness of the body, proportion, quality of the finish, alignment of the wheels, cartridge, and screw eyes. The score will range from 5 to 20 points.

4. Each vehicle will make three time trials on the track. The times will be recorded and the fastest time will be the official race time. The score will be based on this time and will be scored as follows.

Five (5) fastest vehicles	30 points each
Five (5) next fastest vehicles	25 points each
Ten (10) next fastest vehicles	20 points each
Completion of the race	15 points

5. The points scored for each vehicle will be totaled and the highest score will be the winner.

EVALUATION RECORD SHEET

Category	Score
1. Design Planning Sheets	_____
2. Design	_____
3. Workmanship	_____
4. Race	_____
5. Grand Total	_____
6. Overall place	_____

DESIGNING A MARINE VEHICLE

Name: _____ Date: _____

Class Period: _____ Class Time: _____

PROBLEM:

Design a marine vehicle:

1. Determine the displacement of the vehicle.
2. Determine the load capacity of the vehicle.
3. Determine the stability of the vehicle.

DESIGN LIMITATIONS:

1. The maximum size of the vehicle is 4" wide, 12" long, and 2" thick.
2. The vehicle should be designed for maximum load capacity.
3. The material can be wood, cardboard, metal, or any other material.
4. Three view sketches are to be made for each design.

TESTING THE VEHICLE:

1. Sink the vehicle in a small pan of water and measure the increase in the water level. Record this increase in the chart.
2. Determine the displacement of the vehicle by calculating the area of the container times the rise in the water level. Record this number in the chart.
3. Weigh the vehicle and record the weight in the chart.
4. Load the vehicle with sand bags until it sinks. Record this weight in the chart. It may be necessary to hold the vehicle to prevent it from tipping over.
5. Dry the vehicle off and load it until it tips over. Record this weight in the chart. If it does not tip over, then it is very stable and should be given the highest point value for stability.

6. Determine the vehicle weight to water displaced weight. Divide the vehicle weight by the weight of water displaced times 100.

   a. One inch = 2.54 centimeters
   b. One square inch = 6.452 square centimeters.
   c. One cubic inch = 16.307 cubic centimeters.
   d. One pound = 453.592 grams.
   e. One cubic foot of water = 62.4 pounds.
   f. One cubic centimeter = 1 milliliter.

7. Determine the load to vehicle weight ratio by dividing the vehicle weight by the load it took to tip over or sink the vehicle. (Number 4 above).

MARINE VEHICLE TEST DATA SHEET

	Starting Level	Highest Level	Distance Water Raised
1. Water level increase	_____	_____	_____
2. Calculate the volume of water displaced.			_____

-for round containers-

(πr^2 times the water level rise)

3. Vehicle weight _____

4. Largest possible load. _____

5. Stability load. _____

6. Vehicle weight to water displacement (%). _____

(Vehicle weight divided by weight of water displaced times 100)

7. Vehicle load to weight ratio (%).

(Divide the vehicle weight by the load weight times 100)

DETERMINE THE ECONOMY OF A MARINE VEHICLE

Name: _____ Date: _____

Class Period: _____ Class Time: _____

PROBLEM:

Determine the Economy of a Marine Vehicle

1. Determine the capacity of a marine vehicle.
2. Measure the speed of a marine vehicle.
3. Determine the load and speed that will generate the largest profit.

DESIGN LIMITATIONS:

1. The size of the vehicle can not be larger than 4" wide, 12" long, and 2" thick.
2. All vehicles must have the same empty weight.
3. All vehicles will be powered by the same size power source when the efficiency of the vehicle hull is determined.
4. Any size power source may be used in determining the maximum speed of the vehicle.
5. The inside of the vehicle must remain dry during all testing.
6. The cargo must remain dry during all testing.
7. Any load and size power source may be used in determining the economy of the vehicle.

TESTING THE VEHICLE:

1. Testing the efficiency of the vehicle hull design.
   a. Weigh all vehicles. Each vehicle must be loaded until it weighs the same as the heaviest vehicle.
   b. The instructor will place a known weight on the power source string. This weight will be used by all vehicles in this test.

c. Place the vehicle in the test tank and hook the power string to an eye screw in the front of the hull.

d. Place the front of the hull on the starting line.

e. Release the vehicle and record the time it takes to cross the finish line.

f. Calculate the velocity of the vehicle in feet per second.

g. Rerun the test and observe the water at the sides of the hull. Make a sketch of the wave patterns.

h. Rerun the test and observe the water at the back of the hull. Make a sketch of the wave pattern.

i. Which vehicle design was the fastest or most efficient? Compare the wave patterns with the other vehicles.

j. Which vehicle design was the slowest or least efficient? Compare the wave patterns with the other vehicles.

2. Determining the maximum speed of a marine vehicle.

a. This test will be completed with no load in the vehicle.

b. Place the empty vehicle in the test tank and connect it to the power string.

c. Place any weight desired on the power source. Be careful, the vehicle must remain dry. Record this weight in the chart.

d. Place the front of the hull on the start line, release the vehicle and record the time it takes to reach the finish line. If the vehicle remains dry, weight may be added. If the vehicle takes on water, you must remove weight.

e. Calculate the speed of the vehicle in feet per second.

3. Determine the economy of the vehicle.

a. In this test you get pay for the load carried and you must pay for units of power used. The pay and cost schedules are as follows or it may be changed by the instructor:

1. Load pay — $22.75 per ounce.

2. Power cost - $14.25 per ounce.

b. Determine the load and power weight that you want to carry. Record the weight of the load and weight of the power source in the chart.

c. Place the empty vehicle in the test tank and record the time it takes to travel the length of the tank.

d. Place the loaded vehicle in the test tank and record the time it takes to travel the length of the tank.

e. Calculate the profit or loss by working the formula at the bottom of the chart.

MARINE VEHICLE TEST DATA SHEET

TEST # 1

a. Weight of the heaviest vehicle. _____

b. Weight of the power source. _____

e. Time it took to travel the length of the tank. _____

f. Velocity of the vehicle in feet per minute. _____

(distance divided by time)

g. Sketch the wave pattern at the side of the vehicle.

h. Sketch the wave pattern at the back of the vehicle.

i. Sketch the shape of the fastest vehicle. Use a three view sketch.

j. Sketch the shape of the slowest vehicle. Use a three view sketch.

TEST # 2.

c. Weight of the power source. _____

d. Time it takes the vehicle to travel the length of the tank. _____

e. Calculate the speed of the vehicle in feet per second. _____

(Distance divided by time)

TEST # 3

b. Load _____

Power
1. Empty _____
2. Loaded _____

c. Travel time empty _____

d. Travel time loaded _____

e. Profit or loss calculation.

Number of round trips that can be made in a 40 hour week. _____

(144,000 divided by round trip time)

(40 hr. = 2400 minutes or 144,000 seconds)

Number of round trips in 40 hours	Total load delivered in all trips	Total power used in all trips
(A)	(B)	(C)

Profit = A x (B x $22.75) - A x (C x $14.25)

A positive (+) number indicates a profit and a negative (-) number indicates a loss.

DETERMINE THE DISTANCE, DIRECTION, AND TRAVEL TIME BETWEEN LOCATIONS

Name: _____ Date: _____

Class Period: _____ Class Time: _____

PROBLEM:

Determine the distance, direction, and travel time between locations.

1. Locate two points on a map (Example-Louisville and Owensboro, Ky.) and determine the distance between the two locations. Follow the waterway as the marine vehicle would travel.

2. Locate any hazards that may be in the waterway.

3. Using a compass, determine the direction(s) that the marine vehicle will travel.

4. Calculate the time it will take the marine vehicle to reach its destination.

LIMITATIONS:

1. The marine vehicle can travel at an average speed of 22 mph.

2. For each 10,000 pounds carried the marine vehicle will slow down by 0.5 mph.

3. The marine vehicle can travel at top speed twenty-four (24) hours per day seven days a week.

4. The cost of operating the marine vehicle is 58 cents per hour empty. The cost will increase 01 cents per hour for each 10,000 pounds of additional load.

5. The marine vehicle is capable of carrying 100 tons of materials.

6. The marine vehicle will take 25 minutes to get through the average lock.

7. It will take 15 additional minutes to get through each tight turn (90 degree) in the waterway.

DATA AND RECORD SHEET

1. The starting location is _____ and the ending location is _____

2. The distance between the two points is _____

3. The number of hazards such as locks, sandbars, tight turns, etc. are _____.

4. Place a piece of paper over the map and trace the river on the paper. Mark and label the hazards. If there are any questions about the hazards, ask the instructor.

5. It will take _____ hours to get through all the hazards.

6. Trace the marine vehicle's path through the waterway and list the direction(s) the vehicle will travel. Identify each turn with a letter and indicate the direction traveled.

7. Calculate the following costs of transporting materials between the two locations.

   A. 100 tons _____

   B. 25 tons _____

   C. 50 tons _____

8. Which tonnage is the most cost effective?

DESIGN AND CONSTRUCT A HEAVIER THAN AIR VEHICLE

Name: _____ Date: _____

Class Period: _____ Class Time: _____

PROBLEM:

Design a heavier than air vehicle:

1. Design a vehicle that can travel a distance of fifty (50) feet without touching the ground or anything on the ground.

2. No assisting devices, such as strings, may be used.

DESIGN LIMITATIONS:

1. The vehicle must be hand launched. No assisting devices, such as rubber bands, may be used.

2. The vehicle must be made of paper. No other material may be used such as glue, paper clips, tape, etc.

3. Only one (1) sheet of paper 8 1/2 inches by 11 inches may be used in the construction of the vehicle.

5. Design one vehicle for long distance flight.

6. Design one vehicle for a long duration of flight.

7. Design one vehicle that can do loops, turns and/or rolls.

TESTING THE VEHICLE.

DISTANCE FLIGHT

1. Find an open area such as a long wide hall or multipurpose room for testing the vehicles.

2. Make a starting line. Launch the vehicle from this line and measure the distance the vehicle glided. Fly the vehicle five times using different launching techniques. Record the longest flight on the record sheet.

3. Compare the flight of each vehicle and describe some of the reasons for the flight length of each.

DURATION OF FLIGHT

1. Launch the vehicles from a standing position at floor level.

2. The starter/timer will give the launch signal and start the timing device. The time will stop when the vehicle hits the floor, wall, or any object in the room. Record the time on the record sheet.

3. Compare the flight time with the other vehicles and describe why some flew longer than others. Do this in writing on the answer sheet.

ACROBATICS

1. Launch the vehicle several times and make adjustments for loops, turns, and rolls. When the vehicle is adjusted, test fly the vehicle counting the number of loops, turns, and rolls in a single flight. Record this information on the record sheet.

2. Compare each vehicle with the flight of the others and describe in writing why each performed as observed.

TEST DATA FOR HEAVIER THAN AIR VEHICLE

DISTANCE FLIGHT

1. Flight distance
   a. _____
   b. _____
   c. _____
   d. _____
   e. _____

2. Compare the flight distances of each vehicle and describe some of the reasons why some vehicles traveled a greater distance than others. Drawings will help describe or illustrate why the vehicles performed in different ways.

DURATION OF FLIGHT

1. Flight time _____

2. Compare the time your vehicle was in the air with the other vehicles and describe why some stayed airborne longer than others.

ACROBATICS

1. Number of loops _____

2. Number of turns _____

3. Number of rolls _____

4. Compare the number of loops, turns, and rolls accomplished with the other vehicles and describe why some vehicles made more loops, turns, or rolls than others.

DESIGN AND CONSTRUCT A LIGHTER THAN AIR VEHICLE

Name: _____ Date: _____

Class Period: _____ Class Time: _____

PROBLEM:

Design a lighter than air vehicle:

1. Design a vehicle that will float in the air without the aid of external supports.

2. The lifting medium must be hot air.

3. The vehicle must be able to carry a load in a container suspended under the vehicle.

DESIGN LIMITATIONS:

1. The vehicle must be constructed out of paper or plastic.

2. The bottom of the vehicle must be open and must accept the filler tube.

4. The vehicle cannot be over 10 feet high nor exceed the ceiling height in the room.

5. The load carrying compartment must be made of light cardboard and suspended low enough to allow the fill pipe to be inserted into the bottom of the vehicle.

6. The vehicle must be larger at the top than at the bottom.

TESTING THE VEHICLE.

1. Check the construction of the hot air container for loose seams or joints.

2. Insert the hot air fill tube into the bottom of the hot air container.

3. A hot air hair dryer or hot air heat gun should be used as a hot air supply. Do not use any kind of open flame.

4. Turn on the blower motor and start filling the container with cold air. Allow the container to partially fill. Hold the container away from any object that may puncture it and allow the air to escape. Turn on the heating element and continue filling the container. Steady the container being careful not to get burned by the hot sides of the container.

5. When the container will support itself, place one ounce weights into the gondola until it stays in one place, neither rising nor falling. Record this weight on the record sheet.

6. Measure the circumference of the hot air container in three places. Calculate the diameter and record these dimensions on the record sheet.

7. Measure the length of the container and record this dimension on the record sheet.

8. Deflate the container and weigh the container and gondola without the added weights. Record this weight on the record sheet.

9. Calculate the approximate volume of the container.

10. Calculate the total weight of the vehicle including the load carried.

TEST DATA FOR LIGHTER THAN AIR VEHICLE

1. Number of one ounce weights placed into gondola. _____

2. Diameter of the container - position # 1 _____
   $D = \frac{C}{\pi}$ position # 2 _____
   position # 3 _____

3. Length of the container. _____

4. Weight of the container and gondola without weights. _____

5. Determine the approximate volume of the container. Calculate the cross sectional area at each of the three diameters, add them together, divide by three, and multiply this number by the length of the container.

Cross sectional area = πr^2

Volume = Area #1 + #2 + #3 $\div$ 3 X Length of container

6. Compare the above information with the other hot air balloons and explain why others lifted more or less weight.

DETERMINE THE DISTANCE, DIRECTION, AND TRAVEL TIME BETWEEN TWO LOCATIONS

Name: _____ Date: _____

Class Period: _____ Class Time: _____

PROBLEM:

Determine the distance, direction, and travel time between two locations.

1. Determine the direction an air vehicle would have to travel from one location to another. (Example: Paducah, KY to Lexington, KY)

2. Determine the distance between two airports.

3. Determine the time it would take an air vehicle to travel between two locations.

LIMITATIONS:

1. Determine the direction and travel time between two locations when the wind is blowing:

   A. At 20 mph at a 20 degree angle from the left front of the vehicle.

   B. At 30 mph directly behind the vehicle.

   C. At 45 mph directly at the front of the vehicle.

   D. At 15 mph at a 30 degree angle from the right rear of the vehicle.

2. The air vehicle is traveling at 500 mph in each of the above problems.

IMPORTANT INFORMATION THAT WILL BE NEEDED TO CALCULATE THE VELOCITY AND DIRECTION OF THE AIR VEHICLE.

To determnine the distance and direction of travel for the vehicle in each of the above problems it is important to know the principles of forces acting on the object. One important principle is that forces acting in the same direction are added together. For example, if an air vehicle was traveling at 700 mph and had a tail wind of 75 mph, the speed of the vehicle would be 700 mph + 75 mph = 775 mph. This would be the actual speed of the air vehicle.

If the forces were acting in opposite directions, they would be subtracted. For example, an air vehicle is traveling at 400 mph and has a head wind of 35 mph. The actual speed of the vehicle would be 400 mph - 35 mph = 365 mph. These two principles are very important and should be used in the above calculations.

All forces do not act in the same direction or in opposite directions. Many times they act at an angle to each other. This is called angular forces. For example, if a wind is blowing east at 40 mph and the air vehicle is traveling north at 300 mph what direction will the vehicle actually travel. It will not be due north. It will be traveling at a northeastern angle. This can be determined graphically. Make a scale in which 1/4 inch is equal to 50 miles. With this scale, lay out a line equal to 300 miles traveling north. This line will be equal to a speed of 300 mph. At the end of this line construct a line, at a 90 degree angle, 50 miles long. This line will represent the wind traveling east. If the starting point of the 300 mile line and the ending point of the 50 mile line are connected, this new line will show the actual path and direction of travel of the air vehicle. If this angular line is measured it will give the time mecessary to fly the distance between point A and B. The angle between the true north line and the actual line of travel can be measured. To arrive at the correct destination the air vehicle would have to fly at a northwesterly angle equal to the resultant angle. The same procedure can be used for all forces acting at angles other than 90 degrees.

DATA AND RECORD SHEET

1. Place a piece of paper over the map and locate the two air ports. Draw a circle around each airport with a cross locating the center of each airport.

2. Locate north on the map and draw a line pointing north and south. Label the line.

3. Draw a straight line between the two airport centers. Place a compass on this line and determine the direction from the starting point to the ending point.

4. The compass directions between the two locations is/are _____

5. The 20 mph wind direction in part "A" is _____

6. The 30 mph wind direction in part "B" is _____

7. The 45 mph wind direction in part "C" is _____

8. The 15 mph wind direction in part "D" is _____

9. The direction the air vehicle will have to travel in part:

   "A" is _____.
   "B" is _____.
   "C" is _____.
   "D" is _____.

10. The time it will take the air vehicle to travel from the starting location to the ending location in each part is:

    "A" is _____.
    "B" is _____.
    "C" is _____.
    "D" is _____.

DESIGN AND BUILD A LAUNCH TERMINAL

Name:_____ Date:_____

Class Period:_____ Class Time:_____

PROBLEM:

Design and build a launch terminal.

1. Design a launch terminal that will launch a model rocket safely.

2. Build a launch terminal and safely launch a model rocket from the terminal.

DESIGN LIMITATIONS:

1. The electrical system must be six (6) to twelve (12) volts D C.

2. The launch system must be stable and not tip over when a large rocket is launched.

3. The electrical system must contain an on-off switch.

4. The electrical system must contain an ignition (on) switch that will return to the off position when released.

5. The ignition switch (launch position) must be at least fifteen (15) feet from the launch pad.

6. The launch rod must be thirty-six (36) inches long and connected to the launch base in such a manner that it will not be pulled out by the launched rocket.

7. The standard launch rod is one-eighth (1/8) inch in diameter.

8. If the launch rod can be tilted, it must not tilt more than thirty (30) degrees from vertical.

9. A metal exhaust gas deflector shield must be located so that the exhaust will not ignite grass or other flammable materials.

10. Make a sketch of the electrical system and label all parts.

11. Make a sketch of the launch system and label all parts.

CONSTRUCTION OF THE LAUNCH TERMINAL

Check with the instructor for the needed materials and tools. Have the instructor demonstrate the use of all tools and special processes that will be used in the project.

TESTING THE LAUNCH SYSTEM.

1. Connect the electrical system to a power source (6 or 12 volts D C).

2. Connect a volt meter or light bulb to the ignition leads.

3. Turn on the power switch and push the ignition button. Record the reaction of the voltmeter or light bulb on the record sheet.

4. Place a large rocket on the launch rod and test the system for stability. Record the results on the record sheet.

5. If the system checks out, have the instructor sign the record sheet.

6. Move the launch system to a selected safe launch area and launch a rocket. Record in writing the performance of the launch system. Pictures and/or sketches may be used to help illustrate the written report.

NOTE: The space vehicle that will be constructed in TRA-024. or a smaller rocket can be constructed and used as the test vehicle. Construction of a smaller rocket at this time would help develop the skills needed in the construction of the larger rocket.

TEST DATA AND RECORD SHEET

1. Electrical power supply type and voltage. _____

2. Type of electrical test equipment. _____

3. Results when ignition button is pushed. _____

4. Results of placing large rocket on launch system.

5. Instructor's Signature. _____

6. Explain, in detail, the launch of a rocket from the launch system. Some of the items that may be included in the report are:

a. Set up procedures
b. Atmospheric conditions
c. Size of the launch area
d. Problems encountered during the launch
e. Condition of the launch pad before launch
f. Condition of the launch pad after launch
g. Possible improvements in the launch system
h. Other successes or observations

DESIGN AND CONSTRUCT A SPACE VEHICLE THAT WILL TRANSPORT GOODS SAFELY

Name: _____ Date: _____

Class Period: _____ Class Time: _____

PROBLEM:

Design a space vehicle that will transport goods safely.

1. Rocket powered vehicle.
2. One of the four approved recovery methods - glide, tumble, streamer, or parachute.
3. Kit or student designed.

DESIGN LIMITATIONS:

1. The rocket must be of the single engine design.
2. The rocket must be tested for stability.
3. The rocket must be made of approved non-metal parts.
4. The designer-builder must pass a test on the model rocket code.

TESTING THE VEHICLE.

1. Check the vehicle for appropriate use of materials. The vehicle must be made of lightweight materials such as paper, wood, plastic and/or rubber, without metal structural parts. Check the appropriate space on the record sheet.
2. Check the lift off weight of the rocket. The lift off weight, including the engine, must not be over 453 grams or 16 ounces. Record the total lift off weight on the record sheet.
3. Check the vehicle for the appropriate recovery system. Record the type of recovery system on the record sheet.
4. Check the engine. Is it approved for this type of rocket? Record the engine type on the record sheet.
5. Determine the vehicles center of gravity (CG). Mark the center of gravity on the rocket. (Balance the rocket over the edge of a ruler.)

6. Determine the center of pressure (CP). Mark this position on the rocket.
(Cut out an exact-size model of the rocket's profile. Balance this model over the edge of a ruler and mark this location on the rocket.)

7. Is the CG closer to the nose than the CP? If yes, test the stability of the rocket in a wind tunnel or by the swing test. If the CG is closer to the fins than the CP the rocket must be stabilized before flying. Record the results on the record sheet.

8. When the vehicle has passed all checks, it is ready to fly. Record the flight information on the record sheet.

SPACE VEHICLE TEST DATA SHEET

1. List the materials used in the construction of the rocket.

GO ____ NO-GO ____

2. Lift off weight of the vehicle. _____ gram _____ oz

GO ____ NO-GO ____

3. Check the type of recovery system.

Glide ____ Tumble ____ Streamer ____ Parachute ____

GO ____ NO-GO ____

4. The type of engine being used is _____

GO ____ NO-GO ____

5. The CG is _____ inches from the rocket nose tip.

6. The CP is _____ inches from the rocket nose tip.

7. Describe and explain the action of the rocket during the stability test.

GO ____ NO GO ____

8a. The altitude of the rocket was _____ ft.

A. Distance tracking station is from the launch sight _____ ft.
B. Angular distance (angle) of the rocket's flight. _____ degrees
C. Tangent of the angular distance _____
NOTE: See tangent table or altitude chart.
D. A X C = Altitude

8b. The velocity of the rocket was _____

A. $\left(V_2 = \frac{F}{Wav}\right) - 1 \; gt$

V = Velocity in ft./sec.

Wav = average weight of rocket.

F = force (average thrust of rocket engine)

$$*F = \frac{\text{total impulse}}{\text{burn time}} \times \frac{16 \text{ oz.}}{1 \text{ lb.}}$$

g = acceleration due to gravity

(32ft./sec.)

t = burn time in seconds

NOTE: Total impulse and burn time are found in Estes "Model Rocket Catalog" model rocket engine data chart.

TANGENT TABLE

Degrees	Tangent
5	0.0874887
10	0.1763270
15	0.2679492
20	0.3639702
25	0.4663077
30	0.5773503
35	0.7002075
40	0.8390996
45	1.0000000
50	1.1917536
55	1.4281480
60	1.7320508
65	2.1445069
70	2.7474774
75	3.7320508
80	5.6712818
85	11.4300520
* 89	57.2899620

* NOTE: only four degrees difference

The tangent of each angle, not listed, may be found by entering the angle in a scientific calculator and pressing the "tan" key.

The "approximate" tangent number may be found by subtracting the tangents below the measured angle from the tangent above the measured angle. Divide this number by five (5). Add this number to the lower tangent number to find the desired tangent.

EXAMPLE:

Measured flight angle of 43 degrees

Tangent of 45 degrees 1.0000000
Tangent of 40 degrees - 0.8390996

= 0.1609004 ÷ 5 = 0.0321801

(Approximate tangent) 0.8390996 + 0.0321801 + 0.0321801 + 0.0321801 = 0.9356399

43 degrees = 0.9325151

APPENDIX B

DESIGN AND CONSTRUCT A LIGHTER THAN AIR VEHICLE

BACKGROUND INFORMATION ON HOT AIR BALLOONS

Hot air balloons work on the principle of buoyancy. If a cube of fluid (water) is placed in the same kind of fluid (water), it will occupy space in that fluid. If this cube of fluid is replaced with another type of fluid that has a different weight (mercury) it will sink to the bottom of the fluid container. If we replace the heavy fluid with a lighter fluid (oil), it will float on top of the original fluid (water). Each fluid has a different mass; thus, the weight of fluid displaced is greater or less than the inserted cube of fluid. The same is true of air at different temperatures. Hot air has less mass than cold air. If we place hot air inside of a balloon, it will cause the balloon to expand and rise. When the air inside the balloon cools, the balloon will decrease in size and the balloon will fall.

If a gas, other than air, is used, its mass will be greater or less than that of the air. Helium has a mass less than air . If this gas is used, it will cause the balloon to rise even though the two gases are the same temperature. As the balloon rises the atmospheric pressure will decrease. As the atmospheric pressure decreases the balloon will expand. If this expansion is not taken into consideration, the balloon will burst. High altitude balloons start out looking like they are not full. As the balloon rises the container expands until it looks full. When the density of the gas in the balloon reaches the density of the surrounding air, it will stop rising. This is one method of determining the approximate highest altitude of a balloon.

A hot air balloon can take on many shapes. The traditional shape is large at the top and tapered to a smaller diameter at the bottom. Hot air balloons have been made in the shape of animals, cars, houses, etc. It is very important that the top of the balloon be of the largest volume with the gondola at the bottom. If the botton has a larger volume than the top, the balloon may want to turn over. If the gondola is at the top, this can make the balloon top heavy and it can turn over. Keep this in mind as the hot air balloon is designed and constructed.

Make sketches of the hot air balloon. Decide on the material to be used and the actual size of the balloon. If the balloon is going to be of a conventional shape the elliptical panels should be approximately one (1) unit wide and three (3) units long. A circle may be needed to cover the hole at the very top of the balloon. It may be desirable to attach four strings at the largest diameter to control the balloon as it is filled.

Select the desired shape and lay out several panels that can be glued together. The glue must withstand the temperature of the hot air. The balloon must have an opening in the bottom for filling it with hot air. The bottom fill hole must be protected from the hot air. This opening must accept the hot air filling tube. If the heat gun is held under the balloon opening, it may overheat the bottom of the balloon and damage the gondola mounts. Connect the gondola with four strings of sufficient length to allow the insertion of the hot air filler tube.

The hot air filler tube should not be make of metal. The metal could get hot and damage the fill opening of the balloon. A heavy cardboard (drafting tube) and heavy plastic pipe make good fill tubes.

APPENDIX C

TOOLS AND EQUIPMENT LIST

Quantity	Tool
1	Table Saw (optional)
1	Band Saw (optional)
1	Scroll Saw (optional)
1	Lathe (optional)
1	Drill Press (optional)
2	Hand Drill
1	Heat Gun
1	Plastic Strip Heater
1	Pitsco Manual Start Raceway
1	Wind Tunnel
1	Hydro-test Tank
4 sets	Speedbore Bit Set - 1/4" to 1"
6	Hammers
12	Screw Drivers - Standard
12	Screw Drivers - Phillips
6	Pliers
6 sets	Combination Wrenches - 1/8" to 1"
6 sets	Socket Wrench Set - 1/8" to 1"
20	Surform Files - Flat
20	Surform Files - Round
6	Hand Saws
6	Combination Squares
6 sets	Wood Chisels
6	Hack Saw
6	Metal Cutting Snips
6	Fin Aligners
4	Launch Control System
4	Altitude Finder
6	Soldering Gun
1	Miter Box
12	Knife Sets
2 sets	Hex Key Set
12	Files
20	12" Scales
1	100' Steel Measuring Tape
20	Magnetic Compass
6	Stopwatch
6	Marking Gauges
6	Awls
6	Sliding T-Bevels
6	Coping Saws
6 sets	Auger Bits
6	Brace
2 sets	Hole Saws
20	Sissors
20	Dividers

APPENDIX D

SUPPLY LIST

Dragster Kits or
- Wheels, Front
- Wheels, Back
- Axles
- Screw Eyes
- Straws
- Washers
- Body Blanks

Cartridges CO_2
Styrofoam
Cardboard
Cardboard Boxes
Plastic
Sheet Metal
Paint
Felt Tip Markers
Paint Brushes
Glue
Sandpaper
Solder
Rocket Kits
Rocket Engines
Plywood 1/4", 1/2", and 3/4"
Plastic 1/4"
Plaster of Paris
Wood 2" x 4" X 8'
Fishing Line
Screen Wire
Masking Tape
Duct Tape
Posterboard
Maps
Rubber Bands
Tacks
Screws
Plastic Zip-lock Bags
Tissue Paper - Large Sheets
Plastic Garbage Bags
Electrical Wire
Electrical Switches
Batteries 6 or 12 Volt

APPENDIX E

BIBLIOGRAPHY

Books

Cannon, Robert L. Model Rocket Launch Systems. Penrose, CO, Estes Industries, 1976.

Cannon, Robert L. and Michael A. Banks. The Rocket Book. Penrose, CO, Prentice-Hall Inc, 1985.

De Old, Alan R., Everett Sheets, and William Alexander. Transportation The Technology of Moving People and Products. Davis Publications, Inc., Worcester, Massachusetts, 1986. ISBN: 0-87192-126-X

De Old, Alan R., Everett Sheets, and William Alexander. A guide for Teachers Transportation The Technology of Moving People and Products. Davis Publications, Inc., Worcester, Massachusetts, 1986. ISBN: 0-87192-126-X

De Old, Alan R., Everett Sheets, and William Alexander. Activity ACT Manual Transportation The Technology of Moving People and Products. Davis Publications, Inc., Worcester, Massachusetts, 1986. ISBN: 0-87192-126-X

Hammond, Allen L. The Paper Airplane Book. New York, Vintage Book, 1985.

Kline, Richard. The Ultimate Paper Airplane. New York, Simmon And Schuster, 1985.

Stine, G. Harry. Hand Book of Model Rocketry. New York, Arco Publishing Inc, 1983.

RESOURCE MATERIALS

Computer Disk

APPLE:

Cannon, Bob, and Mike Dorffler. Flight Aerodynamics of Model Rockets, No. 9026, Estes Industries, 1295 H Street, Penrose, CO, 81240.

Cannon, Bob, and Mike Dorffler, In Search of Space: Introduction to Model Rocketry, No. 9025, Estes Industries, 1295 H Street, Penrose, CO, 81204.

----------, Glidepath, HRM Software, 175 Tompkins Avenue, Pleasantville, NY, 1057.

----------, Microsoft Flight Simulator, Microsoft Corporation Microsoft Building, 10700 Northup Way, Bellevue, WA, 98001.

Booklets

American Trucking Association, Inc., Educational Services Department, 1616 P Street, N.W., Washington, D.C. 20036

Delta Airlines, Inc., Public Relations Department, Hartsfield-Atlanta International Airport, Atlanta, Georgia 30320

Department of Transportation, Federal Aviation Administration, Washington, D.C. 20591

Motor Vehicle Manufacturers Association of the U.S., Inc., 300 New Center Bldg., Detroit, Michigan 40202

Public Relations Department, Atchison, Topeka and Santa Fe Railway, 80 E. Jackson Blvd., Chicago, Illinois 60604

APPENDIX F

FOR EXAMPLE ONLY
(For detail specifications contact Industrial Education Unit)